

The Chloride-Water Balance Sheet

An Aid in the Management of Difficult Fluid Balance Problems

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DURING THE PAST TWENTY YEARS with an increasing knowledge of the dynamics of exchange of water and electrolytes among the three compartments of the body and a more accurate knowledge of the functions of the various electrolytes it has become possible to accurately diagnose, anticipate and treat severe water and electrolyte problems.

In dealing with certain clinical syndromes it is necessary to have an absolutely accurate determination of intake and output, not only of water but also of electrolytes. These conditions fall into two main categories. First, those in which there are large abnormal losses of water and electrolytes such as occur occasionally with pseudomembranous ileocolitis, obstruction of the small bowel, duodenal fistula, ileostomy, biliary or pancreatic fistula, or following gastric operations, particularly gastroenterostomy and vagotomy. The second category comprises conditions in which the patient has diminished potential output of water and electrolytes, such as chronic nephritis, lower nephron nephrosis and cardiac decompensation. Oliguria caused by acute dehydration is almost invariably cured by adequate administration of water.

In the management of these conditions there must be no estimations or guessing of intake and output, for, as has been demonstrated repeatedly in fatal cases, an error of as much as 300 per cent can thus be made, leading directly to death of the patient.

SIMPLE, ACCURATE RECORDING METHOD

Scribner² in 1949 devised a simple and yet extremely accurate method of recording exactly all intake and output of water and chloride on a consecutive 24-hour basis so that the attending physician might know at all times the water and electrolyte status of the patient, with a cumulate positive or negative balance on an easily read balance sheet from day to day. Scribner stated that an accurate knowledge of all chloride intake and output together with a pH determination on all types of fluid lost obviates the necessity of measurement of other important electrolytes such as sodium and potassium

• In cases in which there is massive loss of fluids or electrolytes or prolonged decreased urinary output, an absolutely accurate knowledge of all water and chloride intake and output by all routes is necessary to avert large and often fatal errors in water and electrolyte therapy based on estimates made from nurses' notes alone.

By use of the Scribner water-chloride balance sheet method of recording data, it is possible to determine with the necessary accuracy how much fluid and what kind of electrolytes to administer to achieve and maintain balance. The method is simple and can be put into effect in any hospital with the cooperation of an educated nursing and laboratory staff.

and that the status of these anions may be estimated most accurately from quantitative chloride concentrations and pH determinations.

PRINCIPLES USED IN CONSTRUCTION AND EVALUATION OF THE BALANCE SHEET

To set up the balance sheet, it is necessary first to estimate the water and electrolyte status of the patient by a careful review of the amount and sources of fluid and electrolyte losses and of the volume of urinary output since the onset of illness. A careful physical examination should then substantiate the impressions gained from the history. Then laboratory determinations of the content of chlorides in the serum, of carbon dioxide combining power, of non-protein nitrogen content and hematocrit should be studied. From all these data the water and electrolyte status of the patient at that particular moment may be fairly accurately estimated. In the author's opinion, serum potassium and serum sodium determinations are unnecessary (as well as impossible in small hospitals without the facilities of a flame photometer) in evaluating this problem, as they may be very accurately estimated from the serum chloride and carbon dioxide combining power determinations as well as from the history of the type of fluids lost. At this time an estimate is made of the variation of chloride (in milliequiva-

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SPECIAL BEDSIDE INTAKE AND INCONTINENCE RECORD

(Replaces Nurses Bedside Record when Patient is on Special Fluid Balance Study)

Clinic No. _____

Name _____ Service of Dr. _____

Sheet No. _____

Date _____

DATE	TIME	INTAKE					SPILLAGE AND INCONTINENCE		NURSES NOTES		
		Oral, Tube feedings, Irrigations, enemas		Intravenous and Subcutaneous			Estimate volume of specimen lost. Do not record specimens saved.	Type of fluid	Vol.	Amt. of Visible perspiration i.e. "None slight" etc.	Treatments and Medications
		Type of fluid	Vol.	Type of fluid and Medications Added.	Rate	Vol. Taken					
8/10	6 PM	SEE DIET CARD S. JONES								NONE	
	10 PM	MILK S. JONES	100	200 POTASSIUM CHLORIDE AND 1cc BERICA C ADDED S. JONES	7 PM 7 PM 1000						LIGHT TO WOUND - 20 MIN. S. JONES EVENING CARE S. JONES
8/11	1 AM	WATER D. SMITH	50				URINE SPILLED D. SMITH	200	PROFUSE		MORPHINE SULFATE GR. 1/4 (H) D. SMITH
	4 AM	NASAL IRRIG. BOTTLE REFILLED D. SMITH	1000				EMESIS ON FLOOR D. SMITH	700	SLIGHT		PATIENT HAD A RESTLESS NIGHT D. SMITH
8/11	7 AM	S.S. ENEMA A. CLARK	500								
	8 AM			2000 cc 5% A. CLARK	8 AM 9 AM 800						MORNING CARE A. CLARK SODIUM CHLORIDE TABS 25M A. CLARK
		End of Period					9 AM	2	11-50		
		1200 cc 5% 9 AM									

Figure 1.—Special bedside intake and incontinence form for accurate recording of nurses' notes. (Scribner.)

No. X Name John Doe Service of Dr. X

Collections Started on 9 AM 6-19-52 Physician's Estimate of DESIRABLE Cumulative Chloride Balance ±500 mEq.

From 9 AM 6-19-52 To 9 AM 6-18-52 Equals 24 Hours CO₂ - 18 mg; Cl - 84 mg; NPN - 6

Volume	ROUTE	Chloride	Volume	OUTPUT	Conc. Cl	Total Cl	pH
100	Oral 1/2 chips	0	600	Urine	32	20	
1000	5% B/S	1500	1000	Sensible & Insensible	0	0	
4470	5% B/W	0	2000	Milker Abbott tube	22	230	
NA	NCI	80	14,200	Colostomy	22	1850	
TOTALS		1580	18,600	TOTALS		1500	

Daily Balance: Water = 3600 cc. Chloride +80 mEq. Cumulative Chloride Balance = 420 mEq. Weight _____ kg.

From 9 AM 6-19-52 To 9 AM 6-19-52 Equals 24 Hours

Volume	ROUTE	Chloride	Volume	OUTPUT	Conc. Cl	Total Cl	pH
150	Oral 1/2 chips	0	1100	Urine	32	35	
1000	5% B/S	1200	1000	Sensible & Insensible	0	0	
800	5% B/W	0	600	Milker Abbott tube	84	50	
NA	NCI	160	5300	Colostomy	91	501	
TOTALS		1360	8200	TOTALS		586	

Daily Balance: Water = ±8000 cc. Chloride 774 mEq. Cumulative Chloride Balance = 354 mEq. Weight _____ kg.

From 9 AM 6-19-52 To 9 AM 6-20-52 Equals 24 Hours

Volume	ROUTE	Chloride	Volume	OUTPUT	Conc. Cl	Total Cl	pH
185	Oral 1/2 chips	0	8100	Urine	54	151	
3000	5% B/W	150	1000	Sensible & Insensible	0	0	
1000	5% B/S	150	300	Milker Abbott tube	96	29	
20	NCI	40	600	Colostomy	98	59	
TOTALS		190	4700	TOTALS		289	

Daily Balance: Water = 11325 cc. Chloride = 91 mEq. Cumulative Chloride Balance = 313 mEq. Weight _____ kg.

From 6-20-52 9 AM To 6-21-52 9 AM Equals 24 Hours CO₂ - 26 mg; Cl - 98 mg; NPN - 24

Volume	ROUTE	Chloride	Volume	OUTPUT	Conc. Cl	Total Cl	pH
600	Oral Water	0	3000	Urine	52	146	
3000	5% B/W	0	1000	Sensible & Insensible	0	0	
			350	Colostomy	96	34	
TOTALS		0		TOTALS		800	

Daily Balance: Water = 900 cc. Chloride = 200 mEq. Cumulative Chloride Balance = 113 mEq. Weight _____ kg.

Figure 2.—Water-chloride balance sheet on Case 1. The patient had pseudomembranous ileocolitis that developed five days after right transverse loop colostomy was performed for obstructing diverticulitis of the recto-sigmoid.

lents) from normal. Here a surprisingly wide range of safety exists, according to Stewart and Rourke⁴ and Marriott,¹ who stated that edema does not occur until the chloride excess reaches plus 800 to 1,000 milliequivalents and that drowsiness leading to coma is absent until the chloride deficit reaches minus 1,000 to 1,500 milliequivalents. Thus a relatively wide margin of error in the estimation of chloride variation at the time of starting the balance sheet may be safely allowed.

The balance sheet is then started and all previous specimens of output discarded. The absolute cooperation of nurses is required for this balance study, and Scribner has printed detailed instructions for them. Routinely a cover is taped over the toilet bowl so that no excretions will be lost, and every cubic centimeter of fluid that comes from the patient by any route is collected in labeled jars, a jar for each type of fluid, and saved in consecutive 24-hour periods for laboratory determination. All intake is accurately recorded on special nurses' notes (Figure 1). The required intake for the first 24 hours is estimated from the original evaluation of the patient's status. At the end of 24 hours a laboratory technician measures the volume of each type of fluid lost, such as urine, feces, gastrointestinal contents and ileostomy drainage, and, by using the bedside determination of chloride as described by Scribner,³ finds the chloride concentration of each sample. The volume and chloride concentration of each type of fluid are then recorded on the output side of the balance sheet for the past 24 hours and a new 24-hour period of collections is begun. Consecutive 24-hour studies are carried out until the patient is out of danger. It is not necessary or advisable to correct severe chloride deficiencies rapidly; it may be done gradually over a period of several days. However, if renal function is normal, water deficiency may be corrected in a short period. As shown in Figures 3 and 4, the cumulative surplus or deficit of chloride and water is carried over from day to day, thereby giving valuable data as to whether the deficiencies or excesses are being corrected.

URINARY CHLORIDE DETERMINATIONS

Urinary chloride determinations as a measure of the chloride status of the body have lost some favor owing to the possibilities of error, principally in three situations: urinary content of chlorides may be low in cases of extreme chloride deficiency, of severe potassium deficiency, or of severe renal disease. However, serial urinary chloride determinations have been demonstrated to be of considerable value in that the chloride status may be evaluated at any specific time with a determination on fresh urine, and day-to-day determinations indicate accu-

rately whether or not a chloride or water imbalance is being corrected.

REPORTS OF TWO CASES

CASE 1. A 63-year-old man, five days after right transverse colostomy for obstructing diverticulitis of the sigmoid, had sudden onset of abdominal cramps and almost constant gushing of watery fluid from the artificial anus, associated with nausea and vomiting. No abnormalities were noted in the abdomen when examination was carried out three hours after the symptoms began. Analysis of fluid losses 8 hours after onset of symptoms showed loss of 7,800 cc. from the artificial anus, 270 cc. as urine and 1,700 cc. through the Miller-Abbott tube. Pseudomembranous ileocolitis was diagnosed and a water-electrolyte balance study was carried out (Figure 2). Suitable replacement therapy was administered and the patient recovered.

Comment: Obviously any attempt at a rough estimate of fluid and electrolyte losses could have been in error by 200 to 300 per cent, which in this case probably would have led rapidly to the death of the patient. The accurate and cumulative recording of all intake and output of water and chloride undoubtedly saved the patient's life.

CASE 2. A 49-year-old white male, eight days after posterior Polya gastrectomy for obstructing duodenal ulcer without insertion of drains at the time of operation down to the duodenal stump, suddenly went into shock, with a drop in blood pressure from 214/90 to 84/30 and a pulse of 140. Complete examination at this time revealed no apparent cause for the shock and no evidence of bleeding or signs of peritonitis. The lungs were clear and there was no evidence of pulmonary embolism or coronary disease. All attempts at correction of shock were unsuccessful. Six hours later the condition had not changed except for some diminution in bowel sounds and questionable slight distention of the abdomen. Empirically a hemostat was slipped through the incision into the peritoneal cavity and approximately 2,500 cc. of bile-stained fluid was expressed. A diagnosis of duodenal stump perforation was made and proper treatment instituted. The urinary output during the next 24 hours was less than 100 cc. Lower nephron nephrosis was diagnosed and a water-electrolyte balance study was begun. The patient was oliguric for 14 days (see Figure 3, A, B and C) with a steady increase in non-protein nitrogen. Diuresis then occurred and the patient recovered. The duodenal fistula was completely closed spontaneously in eight days.

Comment: Lower nephron nephrosis due to prolonged shock necessitates absolutely accurate knowledge of all intake and output in order to avoid overloading the patient with water or electrolytes. The

WATER-CHLORIDE BALANCE SHEET

No. 6,357 Name G. S. W. Service of Dr. Belling
Collections Started at 1900 Physician's Estimate of DESIRABLE Cumulative Chloride Balance 1 Ea.

[illegible]

Daily Balance: Water — 55 cc. Chloride + 14 mEq. Cumulative Chloride Balance: - 103 mEq. Weight — kg.

Cum. $M.M.T. = -30.5cc$		From $3PM. 7-26-52$ To $3PM. 7-27-52$		Hours		Eggs.		24.	
Volume	INTAKE	Chloride	Volume	OUTPUT	Conc. Cl	Res. Cl	pH		
210	Oral	ice chips	0	Urine	48	5			
500	57% glucose in water	95	1000	Serum & Urine	0	0			
500	57% glucose in water	0	1280	Stomach tube	134	172			
40	rectal	20	35	wound suction	80	3			

DATE	DESCRIPTION	AMOUNT	TOTALS
10/1/2010	10/1/2010	100	100
10/2/2010	10/2/2010	100	100
10/3/2010	10/3/2010	100	100
10/4/2010	10/4/2010	100	100
10/5/2010	10/5/2010	100	100
10/6/2010	10/6/2010	100	100
10/7/2010	10/7/2010	100	100
10/8/2010	10/8/2010	100	100
10/9/2010	10/9/2010	100	100
10/10/2010	10/10/2010	100	100
10/11/2010	10/11/2010	100	100
10/12/2010	10/12/2010	100	100
10/13/2010	10/13/2010	100	100
10/14/2010	10/14/2010	100	100
10/15/2010	10/15/2010	100	100
10/16/2010	10/16/2010	100	100
10/17/2010	10/17/2010	100	100
10/18/2010	10/18/2010	100	100
10/19/2010	10/19/2010	100	100
10/20/2010	10/20/2010	100	100
10/21/2010	10/21/2010	100	100
10/22/2010	10/22/2010	100	100
10/23/2010	10/23/2010	100	100
10/24/2010	10/24/2010	100	100
10/25/2010	10/25/2010	100	100
10/26/2010	10/26/2010	100	100
10/27/2010	10/27/2010	100	100
10/28/2010	10/28/2010	100	100
10/29/2010	10/29/2010	100	100
10/30/2010	10/30/2010	100	100
10/31/2010	10/31/2010	100	100
TOTALS	TOTALS	3420	3420

Daily Balance	Water	$\frac{170}{cc}$	Chloride	-85 meq.	Cumulative Chloride Balance	-188 meq.	Weight
Sum	H_2O	$7-27-52$					kg
From	$3 P.M.$	$7-27-52$	To	$3 P.M.$	$7-28-52$	Equals	24 Hours
							$MAX: 210; CO_2: 14; CL: 101$
Volume	INTAKE	Chloride	VOLUME	OUTPUT	Conc. Cl	Poos Cl	pH
180	Oxal	90	Urine	47	4		
1600	see above	0	Serum & transudate	0	0		
1000	5% glucose in water	150	Lavage fluids	126	129		
1000	5% glucose in water	0	Wound exudate	64	3		
TOTALS							
2180				2160			
2180		150		TOTALS		126	

Daily Balance:	Water	+ 30 cc.	Chloride	+ 14 mEq.	Cumulative Chloride Balance:	- 174 mEq.	Weight	— kg.
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[illegible]

Daily Balance:	Water	+430 cc.	Chloride	+72 mEq.	Cumulative Chloride Balance	-102 mEq.	Weight	-- kg.
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Cum 1700: -15										Hours.	
From 3PM 7-29-52 to 3PM 7-30-52 Equpts. 24											
INTAKE					OUTPUT						
Volume	Oil		Chloride	Volume	Lime	Conc. Cl	Boat Cl	pH			
2000	5% gum in tho		0	90	Sensitive & Inertible	56	5				
				0	Swine, tely (removed)	—	0				
				10	Wound suction	20	0				
TOTALS			0	180	TOTALS	5					

Daily Balance:	Water.....cc.	Chloride: -5.....mEq.	Cumulative Chloride Balance: -107.....mEq.	Weight.....lb.
	900			

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Figure 3.—The two sheets reproduced above (A and B) and the sheet on the next page (C) are the water-chloride balance sheet on Case 2. The patient had lower nephron nephrosis following prolonged shock and oliguria for fourteen days followed by diuresis and recovery.

WATER-CHLORIDE BALANCE SHEET

No. _____ Name G. S. W. Service of Dr. Balding
Collections Started at 3 P.M. 7-20-58 Physician's Estimate of DESIRABLE Cumulative Chloride Balance +450 mEq. 420

From 3 P.M. 7:30-5:2 To 8 P.M. 7:21-5:15		Eggs 2.4		Hours	NPN 26; CO ₂ 212 mg; O ₂ 20-30 ml	
Volume	INTAKE	Volume	OUTPUT	Gas. CI	acid CI	pH
0	0	50	50	475	50	7.58
2000	5% glucose in saline	300	1000	0	0	7.58
1000	5% glucose in H ₂ O	0	855	82	70	7.58
			1520	88	133	7.58
			wound surface			
3000	TOTALS	300	3425		205	

Daily Balance:	Water	-425 cc.	Chloride	+95 mEq.	Cumulative Chloride Balance	-355 mEq.	Weight	— kg.
Cum. H ₂ O	=	-425 cc.						

From 3 P.M. 7-21-58		To 3 P.M. 7-22-58		Hours		OUTPUT		pH	
Volume	INTAKE	Chloride	Volume	Urine	Case: Cl	Total Cl			
0	0	0	90	Urine	47	4			
2000	5% glucose in saline	300	1000	Serum & Intestible	0				
1500	5% glucose in water	0	1210	Lavage tube	94	106			
40	Heel	20	1710	Wound suction	97	166			

TOTALS		TOTALS	
3040	320	4040	276

Daily Balance, Water-1000 cc. Chloride + 44 mEq. Cumulative Chloride Balance, -311 mEq. Weight, — kg.		Hours		OUTPUT		Total Cl		pH	
Cum. H ₂ O = -1425 cc		From 3PM, 7:22-52 To 3PM, 7:23-52 Equals 24		Chloride	Volume	Conc. Cl	Total Cl		
1200	120	Dist	ice chips	0	75	42	3		
2000	200	Blurred in 20 min		300	1000	0	0		
2000	200	5% glucose in H ₂ O		0	1410	98	138		
80	80	Kale		40	680	108	75		
TOTALS				340	3175	TOTALS		216	
1200	120								

Daily Balance:	Water	+1025 cc.	Chloride	+124 mEq.	Cumulative Chloride Balance	-187 mEq.	Weight	— kg.
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	VOLUME	INTAKE	Chloride	Volume	OUTPUT	Cocci / Cl	Total Cl	pH
90	Oral	sea chloxa	0	110	Urine	54	6	
1500	5% glucose w/o saline		225	1000	Sensible & Insensibile	8	8	
1000	5% D-glucose in H ₂ O		0	1120	Lavage tube	178	173	
40	MCCB		20	245	Wound swabion	126	31	
TOTALS			245	2475	TOTALS		180	

Daily Balance: Water +155 cc. Chloride +33 mEq. Cumulative Chloride Balance -132 mEq. Weight — kg.
Cum $H_2O = -245$ cc

From 3PM 7-24-53 To 5PM 7-25-53		Eggs 24		Hours		H- 4.2 mg	
Volume	INTAKE	Chloride	Volume	OUTPUT	Total Cl	Total Cl	pH
180	Oral	0	85	Urine	52	4	
500	see chips	150	1000	Semible & Insensible	0	0	
1000	570 glucose in sub	0	980	Swine Fick	132	129	
40	570 glucose in water	20	160	Warmed position	138	22	
40	Ascl						
222.0	TOTALS	170	2225	TOTALS	155		

Daily Balance: Water, = 3 cc. Chloride, = 713 mEq. Cumulative Chloride Balance, = 117 mEq. Weight, = kg.

Cum. H₂O = - 250 cc

A

MC-199

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